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Proceedings of the Pacific regional peer review of the Assessment of Interior Fraser River Coho Salmon Conservation Units' Benchmarks and Status

November 6-7, 2014
Nanaimo, BC

Chairperson: Bruce A. Patten
Editor: Dawn M. Lewis

Fisheries and Oceans Canada
Science Branch
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Nanaimo, BC V9T 6N7

November 2016

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

These Proceedings summarize the relevant discussions and key conclusions that resulted from a Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS), Regional Peer Review (RPR) meeting was held on November 6 and 7, 2014 at the Vancouver Island Conference Centre in Nanaimo to review an assessment of the Interior Fraser River Coho Salmon Conservation Units with respect to Wild Salmon Policy (WSP) benchmarks and status.

Meeting participants included DFO, First Nations, commercial and recreational fishing representatives, environmental non-government organizations, and academia. Three participants had been asked before the meeting to provide detailed written reviews of the working paper.

Participants agreed on the WSP biological status for the Middle Fraser, Fraser Canyon, Lower Thompson, South Thompson and North Thompson CUs. Annual monitoring of the WSP status metric values was recommended as well as a reassessment of the integrated status if there are pattern changes. The benchmarks should be reviewed, and the integrated status should be reassessed, if there are significant revisions to exploitation rates, total spawner, or hatchery-origin spawner data. No evidence for improved smolt-adult survival or a return to the higher productivity regime was found. The status of the CUs appears to be reasonably good under the current productivity regime. However, because the productivity is low, the sustainable harvest that can be expected from the management unit is also low relative to historic levels.

The results of this assessment suggest that the advice reported in Decker et al. (2014) regarding harvest levels remains valid. Further work regarding potential harvest strategies and WSP assessment guidelines is recommended. Participants acknowledged that for future WSP status assessments that there should be increased consideration of the role of ecosystems and habitat. An important success factor for this assessment was the collaborative and inclusive approach that was undertaken; this approach is recommended for future WSP status assessments.

The conclusions and advice resulting from this review will be provided in the form of a Science Advisory Report to Fisheries and Aquaculture Management to inform salmon fishery planning. The Science Advisory Report and supporting Research Document will be made publicly available on the Canadian Science Advisory Secretariat (CSAS) website.

Compte rendu de l'examen par les pairs de la région du Pacifique sur l'Évaluation de l'état des stocks dans les unités de conservation du saumon coho dans le bassin intérieur du fleuve Fraser, dans le cadre de la Politique concernant le saumon sauvage

SOMMAIRE

Le présent compte rendu résume les discussions pertinentes et les principales conclusions de la réunion régionale d'examen par des pairs du Secrétariat canadien de consultation scientifique (SCCS) de Pêches et Océans Canada (MPO), ayant eu lieu les 6 et 7 novembre 2014 au Vancouver Island Conference Centre de Nanaimo, afin d'examiner une évaluation des unités de conservation du saumon coho du Fraser intérieur en ce qui concerne les points de référence et l'état selon la Politique concernant le saumon sauvage (PSS).

Les participants à la réunion regroupaient le MPO, les Premières Nations, des représentants de la pêche commerciale et de la pêche récréative, des organisations non gouvernementales de l'environnement et le milieu universitaire. On a demandé à trois participants avant la réunion de fournir un compte rendu écrit détaillé du document de travail.

Les participants se sont entendus sur l'état biologique selon la PSS pour les UC du mi-Fraser, du canyon du Fraser, de la basse Thompson, de la Thompson Sud et de la Thompson Nord. La surveillance annuelle des valeurs métriques de l'état selon la PSS a été recommandée, ainsi qu'une réévaluation de l'état intégré s'il y a des changements dans les tendances. Les points de référence devraient être examinés et les états intégrés devraient être réévalués en cas de révision importante des taux d'exploitation, du nombre total de reproducteurs, et des données sur les saumons d'élevage géniteurs. Aucun élément probant d'amélioration de la survie des saumoneaux-adultes ou un retour à un régime de productivité élevée n'a été observé. L'état de l'UC semble raisonnablement bon au regard du régime de productivité actuelle. Toutefois, en raison de la faible productivité, la pêche durable à laquelle on peut s'attendre dans l'unité de gestion est également faible par rapport aux niveaux historiques.

Les résultats de cette évaluation portent à croire que les avis scientifiques fournis dans Decker *et al.* 2014 au sujet des niveaux de prise demeurent valides. Des travaux plus approfondis au sujet des stratégies potentielles de pêche et des lignes directrices relatives à l'évaluation selon la PSS sont recommandés. Les participants reconnaissent que pour de futures évaluations de l'état selon la PSS, il conviendrait de prendre davantage en considération le rôle des écosystèmes et de l'habitat. Un important facteur de réussite pour cette évaluation a été l'approche collaborative et inclusive entreprise; cette approche est recommandée pour les prochaines évaluations de l'état selon la PSS.

Les conclusions et avis découlant de cet examen seront présentés sous la forme d'un avis scientifique à l'intention de Gestion des pêches et de l'aquaculture afin d'orienter la planification des pêches au saumon. L'avis scientifique et le document de recherche à l'appui seront rendus publics sur le site Web du calendrier des avis scientifiques du Secrétariat canadien de consultation scientifique.

INTRODUCTION

A Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS), Regional Peer Review (RPR) meeting was held on November 6 and 7, 2014 at the Vancouver Island Conference Centre in Nanaimo to review an assessment of the Interior Fraser River Coho Salmon Conservation Units with respect to Wild Salmon Policy (WSP) benchmarks and status (Fisheries and Oceans 2005).

The Terms of Reference (TOR) for the science review (Appendix A) were developed in response to a request for advice from Fisheries and Aquaculture Management Branch. Notifications of the science review and conditions for participation were sent to representatives with relevant expertise from First Nations, commercial and recreational fishing sectors, government agencies, environmental non-governmental organizations and academia.

The following working paper (WP) was prepared and made available to meeting participants prior to the meeting (working paper abstract provided in Appendix B):

Wild Salmon Policy Biological Status Assessment for Conservation Units of Interior Fraser River Coho Salmon (*Oncorhynchus kisutch*) by Parken, C.et al. (CSAP Working Paper 2014/15 SAL12)

The meeting Chair, Bruce Patten, welcomed participants, reviewed the role of CSAS in the provision of peer-reviewed advice, and gave a general overview of the CSAS process. The Chair discussed the role of participants, the purpose of the various RPR publications (Science Advisory Report, Proceedings and Research Document), and the definition and process around achieving consensus decisions and advice. Everyone was invited to participate fully in the discussion and to contribute knowledge to the process, with the goal of delivering scientifically defensible conclusions and advice. It was confirmed with participants that all had received copies of the Terms of Reference, working paper, and written reviews.

The Chair reviewed the Agenda (Appendix C) and the TOR for the meeting, highlighting the objectives and identifying the Rapporteur for the review. The Chair then reviewed the ground rules and process for exchange, reminding participants that the meeting was a science review and not a consultation. The room was equipped with microphones to allow remote participation by web-based attendees, and in-person attendees were reminded to address comments and questions so they could be heard by those online.

Members were reminded that everyone at the meeting had equal standing as participants and that they were expected to contribute to the review process if they had information or questions relevant to the paper being discussed. In total, 43 people participated in the RPR (Appendix D). Dawn Lewis was identified as the Rapporteur for the meeting.

Participants were informed that Diana Dobson, Mike Hawkshaw and Jake Schweigert had been asked before the meeting to provide detailed written reviews for the working paper to assist everyone attending the peer-review meeting. Participants were provided with copies of the written reviews in advance of the meeting.

The conclusions and advice resulting from this review will be provided in the form of a Science Advisory Report to Fisheries and Aquaculture Management to inform salmon fishery planning. The Science Advisory Report and supporting Research Document will be made publicly available on the Canadian Science Advisory Secretariat (CSAS) website.

PRESENTATION OF WORKING PAPER

Charles Parken, the lead author of the working paper, gave a presentation based on the contents of the working paper. This was followed by an opportunity for participants to ask questions for clarification of the information presented.

PRESENTATION OF WRITTEN REVIEWS

JAKE SCHWEIGERT

Jake Schweigert provided a written review (Appendix E) in advance and summarized this in a presentation at the meeting.

MIKE HAWKSHAW

Mike Hawkshaw provided a written review (Appendix E) in advance and summarized this in a presentation at the meeting.

DIANA DOBSON

Diana Dobson provided a written review (Appendix E) in advance and summarized this in a presentation at the meeting.

GENERAL DISCUSSION

The following section summarizes the general discussion that occurred subsequent to the formal reviewer presentations. Below are the major points from the discussion. These points are followed by more detailed descriptions.

CHOICE OF ASSESSMENT APPROACH

The participants expressed the need for some background information on how the assessment approach for the working paper had been selected. To assist with this, Arlene Tompkins delivered a short presentation on the role of the Salmon CSAS Oversight Committee in order to provide some clarity on how the objectives for the working paper were established. Members of the committee worked with the lead author and the advice requestor to develop the TOR. They also prepared a Project Initiation Document to define scope of the work and to obtain agreement on the resources to be involved.

The approach for this assessment was based on previous review processes to determine WSP status for Fraser Sockeye (Grant & Pestal 2013) and for Southern BC Chinook[1] conservation units. For all three of these assessments, a workshop was conducted using a form of the Delphi method to determine the expert opinion on the status of each Conservation Unit (CU). However, unlike the Fraser Sockeye and Southern BC Chinook processes, for this assessment the results of the workshop were then used to develop a working paper that is the subject of this review. The purpose of this RPR is to review the outcome of the expert workshop and not the Delphi method since this method has already been the subject of review in this context.

[1] Brown, G.S., Thiess, M.E., Pestal, G., Holt, C.A., and Patten, B.A. 2016. Integrated Biological Status Assessments under the Wild Salmon Policy Using Standardized Metrics and Expert Judgement: Southern British Columbia Chinook Salmon (*Oncorhynchus tshawytscha*) Conservation Units. Unpublished data.

The participants asked how the workshop participation was determined and whether it was sufficiently inclusive. Technical experts from DFO, First Nations, environmental organizations and the fishing industry were invited to the workshop; though not all accepted the invitation. Furthermore, it was noted that similarly broad participation at this review meeting was pursued through direct invitation and through posting of the meeting TOR via the CSAS website.

The authors were asked why they did not include any habitat-based benchmarks in the working paper. It was explained that such benchmarks were not requested in the objectives of the TOR and that biological benchmarks derived from stock-recruitment analysis were used for this process.

DATA QUALITY AND ANALYSIS

The source and data treatments for the escapement data used in the analysis were discussed. It was explained that the escapement data were queried from DFO's regional escapement database known as nuSEDS. The data treatments applied in this case were similar to the approaches taken for Fraser Sockeye and Southern BC Chinook and all three made use of the same "dashboard" presentation format.

The coded-wire tag information was queried from the Regional Mark Information System (RMIS), a database which combines information from several agencies, including DFO. It was suggested that it might be more appropriate to draw Canadian coded-wire tag information from DFO's own Mark Recovery Program (MRP) database. However, the authors chose RMIS over MRP because they encountered some data quality concerns with the MRP data. The RMIS data were reviewed with Salmonid Enhancement Program staff to confirm accuracy.

BIOLOGICAL STATUS ASSESSMENT

Participants who had experience at an expert status integration workshop for WSP status assessments expressed confidence in the process for determination of status. However, participants who had not yet attended such a workshop were less confident in the method. The development of a standard protocol document for the status integration process was identified as a valuable subject for future work. Similarly, some work to develop a roadmap of the process from status assessment to informing fisheries management decisions would be helpful.

The interpretation of a "mixed" status of AMBER/GREEN was a concern for participants. This could lead to a suggestion that there are actually five statuses (RED, RED/AMBER, AMBER, AMBER/GREEN, GREEN) and not three (RED, AMBER, GREEN) as defined by the WSP. This concern highlights the importance of consulting the status narrative that accompanies each status assessment in order to fully understand the details of the assessment. The narratives will clearly describe what the rationale was for the status assignment. The use of a mixed status is intended to demonstrate the uncertainty with the assessment; that is, the experts could not reach consensus on whether the status was in one zone or the other. It is not intended to be an indication that the CU is in some overlap status zone between one status and another.

STATUS RE-ASSESSMENT TRIGGERS

Once a WSP status has been determined for a CU, it will remain valid for some period but should then be re-assessed to determine whether the status has changed. The working paper provided advice on just what conditions or situations would trigger the need for re-assessment. The participants discussed these considerations and commented that the level of uncertainty with an assessment could also indicate the need for re-assessment. A mixed status assessment of AMBER/GREEN is an example of such a situation.

The value of a status metric may change on a frequent basis, e.g. annually. The participants considered whether this would be an indication of the need for a full status re-assessment. The potential for annual change in a trend metric can be seen when the dashboard for that metric is studied. If the history of that metric demonstrates variability, this is an indication that a sustained change would be required in order to suggest the need for status re-assessment.

CONCLUSIONS

The participants' consensus was that the paper should be accepted with revisions. A summary of conclusions from the review are provided below.

- The WSP biological status was AMBER for the Middle Fraser, Fraser Canyon and South Thompson CUs and it was AMBER/GREEN for the Lower and North Thompson CUs.
- The WSP status metric values should be monitored annually and integrated status should be reassessed when there are signs that productivity, spawner abundance, smolt-adult survival, or smolt production patterns change.
- The benchmarks should be reviewed, and the integrated status should be reassessed, if there are significant revisions to exploitation rates, total spawner, or hatchery-origin spawner data.
- This assessment found no evidence for improved smolt-adult survival or a return to the higher productivity regime.
- The status of the CUs appears to be reasonably good under the current productivity regime. However, because the productivity is low, the sustainable harvest that can be expected from the management unit is also low relative to historic levels.

RECOMMENDATIONS & ADVICE

- The results of this assessment suggest that the advice reported in Decker et al. (2014) regarding harvest levels remains valid.
- Further work regarding potential harvest strategies, which include analyses for both high and low productivity regimes, is recommended.
- Further work on WSP assessment guidelines, utilizing the lessons learned from this and previous WSP integration processes, and from similar processes in other jurisdictions, is recommended.
- It was acknowledged that for future WSP status assessments that there should be increased consideration of the role of ecosystems and habitat.
- An important success factor for this assessment was the collaborative and inclusive approach that was undertaken; this approach is recommended for future WSP status assessments.

ACKNOWLEDGEMENTS

The Chair thanks the reviewers for their expertise in reviewing the working paper, and all of the participants for their constructive engagement in the science review process at this meeting. Dawn Lewis is thanked for being the meeting rapporteur and editor of the proceedings document. Marilyn Hargreaves' and Ann Mariscak's assistance in providing CSAS meeting support is greatly appreciated.

REFERENCES CITED

Decker. A.S., Hawkshaw, M.A., Patten, B.A., Sawada, J. and Jantz, A.L. 2014. Assessment of the Interior Fraser Coho Salmon (*Oncorhynchus kisutch*) Management Unit Relative to the 2006 Conservation Strategy Recovery Objectives. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/086. xi + 64 p. (Accessed 9 November 2016)

Fisheries and Oceans Canada. 2005. Canada's Policy for Conservation of Wild Pacific Salmon. Fisheries and Oceans Canada, Vancouver, BC. 34 p. (Accessed 9 November 2016)

Grant, S.C.H. and Pestal. G. 2013. Integrated Biological Status Assessments Under the Wild Salmon Policy Using Standardized Metrics and Expert Judgement: Fraser River Sockeye Salmon (*Oncorhynchus nerka*) Case Studies. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/106. v + 132 p. (Accessed 9 November 2016)

APPENDIX A: TERMS OF REFERENCE

Assessment of Interior Fraser River Coho Salmon Conservation Units' Benchmarks and Status

Regional Peer Review Process – Pacific Region

November 6-7, 2014
Nanaimo, BC

Chairperson: Bruce Patten

Context

Interior Fraser River (IFR) Coho Salmon (*Oncorhynchus kistuch*), which include North Thompson, South Thompson, Lower Thompson, Fraser Canyon and Middle Fraser Conservation Units (CUs), have experienced repeated years of low returns and there is a high degree of uncertainty about their longer term abundance and productivity. During the 1990s, declines in the abundance of IFR Coho Salmon prompted Fisheries and Oceans Canada (DFO) to implement several measures to significantly reduce the harvest of these stocks. In 2002, IFR Coho Salmon were designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered (COSEWIC, 2002). In 2006 DFO published a conservation strategy outlining recovery objectives for IFR Coho Salmon.

In accordance with Canada's Policy for the Conservation of Wild Pacific Salmon (WSP) Strategy 1 Canada is required to assess the biological status of WSP Conservation Units (CUs) for Pacific salmon. Fisheries Resource Management Branch has requested that Science Branch provide advice respecting the biological benchmarks, consistent with the Wild WSP, and to assess the biological status of the IFR Coho CUs. Results of the assessment, and advice arising from this Regional Peer Review process, will be used by Fisheries Management.

This Canadian Science Advisory Secretariat (CSAS), Regional Peer Review (RPR) will utilize the data reviewed during CSAS RPR held February 2014, and approaches developed to assess WSP biological status for Fraser River Sockeye and Southern B.C. Chinook Salmon, to provide advice about WSP biological benchmarks and status for Interior Fraser River Coho CUs.

Objectives

The following working paper will be reviewed and provide the basis for discussion and advice on the specific objectives outlined below.

Parken, C.et al. Assessment of the Interior Fraser River Coho Salmon Conservation Units, Benchmarks and Status. CSAP Working Paper 2014/15 SAL12.

1. Develop WSP biological benchmarks for IFR Coho Salmon CUs.
2. Determine WSP biological status for each IFR Coho Salmon CUs.
3. Provide advice on an approach that would trigger a re-assessment of IFR Coho Salmon CUs benchmark(s) and status.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document(s)

Participation

- Fisheries and Oceans Canada (DFO) (Science, Fisheries Management, and Salmonid Enhancement Program)
- First Nations
- Commercial and Recreational Fishing Representatives
- Environmental Non-government Organizations
- Academia

References

Fisheries and Oceans Canada. 2005. Canada's Policy for Conservation of Wild Pacific Salmon. Fisheries and Oceans Canada, Vancouver, BC. 34 pp. (Accessed 27 October 2016)

Grant, S.C.H., MacDonald, B.L., Cone, T.E., Holt, C.A., Cass, A., Porszt, E.J., Hume, J.M.B., and Pon, L.B. 2011. Evaluation of uncertainty in Fraser Sockeye (*Oncorhynchus nerka*) Wild Salmon Policy status using abundance and trends in abundance metrics. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/087. viii + 183 p. (Accessed 9 November 2016)

Holt, C.A. 2009a. Evaluation of benchmarks for Conservation Units in Canada's Wild Salmon Policy: technical documentation. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/059. xii + 50 p. (Accessed 9 November 2016)

Holt, C.A., Cass, A., Holtby, B., and Riddell, B. 2009b. Indicators of status and benchmarks for conservation units in Canada's Wild Salmon Policy. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/058. viii + 74 p. (Accessed 9 November 2016)

APPENDIX B: ABSTRACT OF WORKING PAPER

Wild Salmon Policy Biological Status Assessment for Conservation Units of Interior Fraser River Coho Salmon (*Oncorhynchus kisutch*) by Charles Parken, Lynda Ritchie, Bronwyn Macdonald, Richard Bailey, Pete Nicklin, Mike Bradford, Hillary Ward, Paul Welch, Ian Boyce, Arlene Tompkins, Marla Maxwell, Katie Beach, Jim Irvine, Sue Grant, Pieter Van Will, David Willis, Mike Staley, Michelle Walsh, Joel Sawada, Jamie Scroggie and Elinor McGrath.

The Wild Salmon Policy outlines a modern approach for managing Canada's salmon resources. The approach involves developing benchmarks and determining the biological status of Conservation Units (CUs). In order to apply this approach to Interior Fraser Coho (IFC) salmon (*Oncorhynchus kisutch*), abundance-based benchmarks were developed and a comprehensive set of population dynamics, abundance, trend, distribution, and productivity information were reviewed for each of the five CUs. After reviewing this information in a workshop of scientific experts, three CUs were determined to be AMBER status and two were AMBER/GREEN status by consensus, and that status should be re-evaluated when CU characteristics such as productivity, spawner abundance, smolt-adult survival or underlying data change. The IFC have been in a low productivity regime for two decades since smolt-adult survival declined. The low smolt-adult survival conditions have persisted, with no signs of sustained increase to historic levels. Smolt-adult survival data were used to back-calculate smolt production indices from adult recruitment, and it was found that much of the variation in adult spawner abundance over the last decade resulted from variation in freshwater survival and smolt production. Smolt production was estimated to be high over the last two brood years, with the most recent year being the highest in the time series for three CUs. Smolt production has trended upward since 1995 for the Lower Thompson CU alone. Stock-recruitment analyses showed that increased density-independent survival was limited to the recent two to five brood years, depending on the CU. The analysis also found that these CUs currently have low productivity, low carrying capacity, and experience frequent recruitment failures across the range of spawner abundance due mainly to high variation in freshwater survival. Over the last decade the management regime has become stationary, more balanced with the current productivity, and spawner abundance has stabilized at levels suitable for optimal production of smolts from the freshwater environments. However, sustainable yield continues to be limited by low smolt-adult survival. These conditions should maintain the productive capacity of IFC CUs until the productivity regime changes again.

APPENDIX C: AGENDA

CSAS Regional Peer Review Meeting (RPR)

Assessment of Interior Fraser Coho Conservation Units' Benchmarks and Status

6-7 November, 2014

Vancouver Island Convention Centre, Nanaimo B.C.

Chair: Bruce Patten

DAY 1 – Thursday, November 6th, 2014

Time	Subject	Presenter
0900	Introductions Review Agenda & Housekeeping CSAS Overview and Procedures	Chair
0915	Review Terms of Reference	Chair
0930	Presentation of Working Paper	Authors
1030	***Break***	
1050	Overview Written Reviews	Chair + Reviewers & Authors
12:00	***Lunch Break***	
1300	Identification of Key Issues for Group Discussion	Group
1330	Discussion & Resolution of Technical Issues	RPR Participants
1445	***Break***	
1500	Discussion & Resolution of Results & Conclusions	RPR Participants
1630	Review Parking Lot Issues and Confirm Agenda for Day 2	RPR Participants
1700	***Adjourn for the Day***	

DAY 2 – Friday, November 7th, 2014

Time	Subject	Presenter
0830	Introductions Review Agenda & Housekeeping Review Status of Day 1	Chair
0845	*(As Necessary)* Carry forward outstanding issues from Day 1	RPR Participants
1000	Develop Consensus on Paper Acceptability & Agreed-upon Revisions	RPR Participants
1030	***Break***	
1050	Science Advisory Report (SAR) Develop consensus on the following for inclusion: • Sources of Uncertainty • Results & Conclusions • Additional advice to Management (as warranted)	RPR Participants
1200	***Lunch Break***	
1300	Science Advisory Report (SAR) • Continued	RPR Participants
1445	***Break***	
1500	Next Steps – Chair to • SAR review/approval by participants and timelines • Research Document & Proceedings timelines • Other follow-up or commitments (*as necessary)*	Chair
1545	Other Business arising from the review	Chair & Participants
1600	***Adjourn meeting***	

APPENDIX D: PARTICIPANTS

Last Name	First Name	Affiliation
Allan	Dean	DFO Fisheries Management BC Interior
Bailey	Richard	DFO Science Fraser River
Baillie	Steve	DFO Science South Coast
Beach	Katie	Okanagan Nation Alliance
Blackbourn	Dave	DFO, retired
Boyce	Ian	DFO Science Yukon
Cox-Rogers	Steve	DFO Science North Coast
Decker	Scott	DFO Science South Coast
Dobson	Diana	DFO Science South Coast
Galbraith	Ryan	DFO Salmonid Enhancement Program
Grant	Sue	DFO Science Fraser River
Grout	Jeff	DFO Fisheries Management
Hargreaves	Marilyn	DFO Centre for Science Advice Pacific
Hawkshaw	Mike	University of British Columbia
Holmgren	Diego	Tulalip Tribes
Irvine	Jim	DFO Science Salmon and Freshwater Ecosystems
Kadowaki	Ronald	DFO Fisheries Management
Komick	Nicholas	DFO Science Salmon and Freshwater Ecosystems
Lewis	Dawn	DFO Science Salmon and Freshwater Ecosystems
Luedke	Wilf	DFO Science South Coast
MacDonald	Bronwyn	DFO Science Fraser River
Maxwell	Marla	DFO Fisheries Management Fraser River
Morishima	Gary	Quinault Nation
Ned	Murray	Lower Fraser Fisheries Alliance (LFFA)
Nicklin	Pete	Fraser River Aboriginal Fisheries Secretariat
O'Brien	David	DFO Science South Coast
O'Farrell	Danny	Nuu-chah-nulth Tribal Council (Uu-a-thluk)
Parken	Chuck	DFO Science Fraser River
Patten	Bruce	DFO Science Salmon and Freshwater Ecosystems
Rankis	Andy	Northwest Indian Fisheries Commission
Ritchie	Lynda	DFO Science Fraser River
Sawada	Joel	DFO Science Salmon and Freshwater Ecosystems
Schweigert	Jake	DFO, retired
Scroggie	Jamie	DFO Fisheries Management Fraser River
Singer	Kris	DFO Science Fraser River
Staley	Mike	Fraser River Aboriginal Fisheries Sec.
Sterritt	Gord	Upper Fraser Fisheries Conservation Alliance
Tompkins	Arlene	DFO Science Salmon and Freshwater Ecosystems
Van Will	Pieter	DFO Science South Coast
Walsh	Michelle	Shuswap Nation
Weitkamp	Laurie	National Marine Fisheries Service
Whitehouse	Timber	DFO Science Fraser River
Willis	Dave	DFO Salmonid Enhancement Program
Zimmerman	Mara	Washington Department of Fish and Wildlife

APPENDIX E: WORKING PAPER REVIEWS

Date: October 30, 2014

Reviewer: Diana Dobson, SC STAD DFO

CSAS Working Paper: 2014/15 SAL12

Working Paper Title: Wild Salmon Policy Biological Status Assessment for Conservation Units of Interior Fraser River Coho Salmon (*Oncorhynchus kisutch*)

SUMMARY

Overall, this paper makes presents a thorough and very competent review of the available data and implementation of Wild Salmon Policy (WSP) standardized stock status assessments of Interior Fraser coho. The paper is well written and the information is presented in a clear and succinct manner. At the same time, the limitations of the data, application of the method, and analysis raise some interesting questions with regard to implementing the objectives associated with Canada's Wild Salmon Policy (WSP). I'm not sure these issues are necessarily deficiencies of the paper, but they should be addressed through either this CSAP process or through other plenary processes where more suitable.

The Terms of Reference for this CSAP review states the objectives of the paper are to:

1. Develop WSP biological benchmarks for IFR coho salmon CUs.
2. Determine WSP biological status for each IFR coho salmon CUs.
3. Provide advice on an approach that would trigger a re-assessment of IFR coho salmon benchmarks and status.

The first two objectives are straightforward. Notwithstanding review and discussion of the methods, results and conclusions, the authors complete these tasks. It's not clear that third objective was achieved, although the specific intent of the third objective is unclear to me and probably was to the authors. However, there is information and analysis presented in the paper which likely informs the issue and advice can be crafted from the resulting discussion of this CSAP process.

The detailed review is below. The key outcomes or conclusions of the paper that I think require further discussion by the sub-committee include:

1. **Discuss whether or not the data support the conclusions with regard to biological status.** With the exception of one benchmark, all of the standardized WSP benchmarks that were applied resulted in "green" status for the five IFR coho CUs. However, through the integrated assessment approach each CU was downgraded largely based on the auxiliary information supplied to workshop participants. However, the auxiliary data that drove the status downgrades were redundant to the standardized benchmarks.
2. **Review and discuss the application of the consensus-based method for integrated status assessments.** There should be a record in the proceedings of why this method was applied, how well it worked and under what conditions this approach is recommended. I think it is important to note the authors' contribution to streamlining the process through adapting methods and tools already applied. The CU assessment process requires some flexibility and does not have to be rigid given the variation in available data, resources, and capacity and management issues.
3. **Further discuss the third objective of the TOR for this review – i.e. "provide advice on an approach that would trigger a re-assessment of IFR coho salmon benchmarks and**

status." Factors that might trigger a change in the assessment could be an actual change in status; change in the conditions associated with the benchmarks (i.e. shift in from the current "productivity regime"); or change in the assessment framework and/or management framework. The authors provide commentary with regard to this question. With further discussion the sub-committee may be able to formulate advice for the proceedings or SAR.

4. **Discuss whether the conclusions made in the paper are justified by the data and results.** My specific concerns are with the commentary on the effect of the exploitation rate regime on stock status. The analysis to support that discussion was completed through another CSAP review (i.e. Decker et al. 2014). The results presented in this paper do not support the discussion.

REVIEW

Introduction

The introduction provides a sufficient overview of the significant management actions in fisheries that have occurred since 1989 in response to declines in abundance of IFR coho. However, I think more detail can be added with regard to the initial stock assessments that triggered that response and subsequent stock assessments that were made under the recovery planning process. Importantly, reference points were defined under the recovery plan. How were they defined? How were they used? What makes them different then the WSP benchmarks or "WSP biological status" assessment determined in this paper? This additional background detail would provide useful context for understanding some of the issues that are raised later in the discussion.

Also, in listing the objectives of the paper defined in the TOR, I think the authors could also introduce the approaches that are utilized in the paper and contributions they make. For example, why did they use the consensus-based approach to determining an "integrated" biological status? Or, why do they use stock-recruit analysis to define abundance benchmarks? These approaches may not be required or possible in every situation. For example, papers presented earlier this week use different methods.

Methods

Data sources and treatment:

Overall, the data sources and treatment are clearly described as well as sources of uncertainty in the data. The paper is efficient in that it effectively uses and references techniques that have already been applied in previous WSP analysis. Also, the authors do not get caught up in slight variations in methods, such as interpolation techniques, for which the analysis and results are typically not sensitive to.

Some specific comments:

- NuSEDs data classifications were used to rank the quality of spawner data. I believe these classifications need to be reviewed. On the one hand, they place too much emphasis on methodology as opposed to reliability of the estimate. On the other hand, they have been rather subjectively interpreted and applied over the years. Use of these classifications is not necessarily a deficiency of the paper, but an area for further research and advice within DFO Science. Other jurisdictions, such as New Zealand, have made extensive progress in defining data standards. (This issue is becoming increasingly important as rely on external sources, or "community science" for our data.)
- While the paper points out many sources of uncertainty, it would be useful to have more comments on the magnitude of those sources even if these comments are more qualitative

in nature. For example, what is the likely extent of "unauthorized catch"? Is it considered a major deficiency or likely only minor?

Data Analysis:

- The methods used are clearly described and, again, efficiently applied in that they build off work from other IFR coho and WSP assessments.
- The paper might benefit from some minor reorganization. Some of the description in the sections describing the stock-recruit analysis and how it was applied to determine abundance based benchmarks might belong in either the introduction and/or discussion – i.e. to "tell the story" more.
- The paper evaluates current spawning population distribution relative to objectives set out in the IFR coho recovery plan. I have no objection to that approach as the distribution objectives in the IFR coho recovery plan were scientifically defensible and set to achieve specific biological objectives consistent with the WSP. Moreover, the distribution indices presented in Holt et al. (2009) are typically difficult to apply given data limitations. However, for most other CUs these kinds of distribution objectives will not be defined. This is an area where further research or guidance from DFO Science would improve our assessments.

Biological Status Evaluation Approach:

The method builds off consensus-based approaches to status assessments that have been applied for other species and CUs (i.e. Fraser sockeye and SBC chinook.) The general process that was applied was similar – i.e. compilation of the data through a technical advisory group, use of "dashboards" to summarize data for CUs (additionally CUs are not named in the dashboard), use of a workshop approach to review data and to seek consensus on status based on specific criteria (abundance relative to benchmark, decline rate, etc.).

However, in this instance there are some modifications in how the method was applied. For example:

- The technical working group perhaps did a bit more editing of what information was included in the dashboards prior to the workshop. Their considerations were dependent on the type and quality of data that were available and characteristics of the species/CUs being assessed. I suspect this step this step greatly improved the efficiency of the eventual workshop and overall process.
- The type of participants involved in the integrated assessment workshop may also have differed that those participating in the CSAP workshops. I understand prior to the workshop a lot of time was spent by the technical committee building understanding and trust among the eventual workshop participants with regard to the data sources and treatment. This step was likely very important and it would be useful to describe why it was required and what was involved. (I take it not every CU assessment will require this level of work or even a workshop, but in some cases they may absolutely integral to moving forward not only with the assessment but also, eventually, management plan development.)
- Consensus in the status assessment was sought prior to presentation of the results in this CSAP process. This raises the question: In reviewing whether the data and methods support the conclusions, are we accepting the results of the consensus assessment so long as the workshop method was applied reasonably and/or are we also reviewing the conclusions made through the workshop based approach?
- The information that was supplied to the workshop participants included auxiliary information on page 3 of the "dashboard". It is really important to note that these data seemed to have

the strongest bearing on the eventual integrated status assessments, yet the information is mostly descriptive – i.e. trends are presented, but not evaluated according to a standardized method or benchmark. (See further discussion on this point below.)

In any case, some of these changes in how the integrated assessment workshop method was applied should be identified and discussed – perhaps not in the working paper, but at least in the proceedings of this CSAP meeting. An evaluation of how well the consensus-based method worked in this case and what was learned should be described. The conclusions bear on the overall implementation of WSP and are of interest to managers when allocating assessment resources. (I think one contribution of the assessment presented in this paper is that they effectively streamlined the approach.)

Results

Abundance based benchmarks:

Presentation of the results is very clear (Table 8); including the "dashboard" summaries for the stock-recruit analysis from which the benchmarks were derived (Figs. 9 through 13).

Biological status inferences:

- The most important result for the sub-committee to consider is that, with the exception of one benchmark for one CU, all of the "standardized WSP metrics of biological status" that were presented for the 5 CUs were in the "green zone" – i.e. 19 out of 20 indicators presented were green. However, the integrated assessment workshop resulted in categorization of each CU below the "green zone". **With regard to this outcome the CSAP sub-committee should carefully review whether or not the data supports the conclusions made in the integrated assessment workshop.** That is, despite the fact that 95% of the standardized benchmarks were "green", none of the IFR coho CUS were assessed to be in the "green" zone.
- In the narrative summary of the integrated assessment results, the key factors that seemed to drive the biological assessments below the green level were concerns regarding stock productivity and concerns regarding uncertainty in the data sets or treatment (e.g. uncertainty in the stock-recruit relationship).
    - With regard to productivity, the fact that the stock has "not replaced itself" at a frequent enough rate is often cited from the auxiliary information presented in the dashboards as the reason for the lower-than-green integrated assessment. However, in itself, "stock not replacing itself" is a lousy and subjective indicator. No one expects large spawning abundances to always be replaced; it becomes a conservation problem when there is a downward trend involved.

      Moreover, the stock-recruit analysis for which the abundance benchmarks are derived inherently use the same data. Similarly, the standardized WSP benchmarks for stock trends inherently index how well the population is or is not replacing itself over three generations.

      Therefore, redundant information has been used in this paper to come up with different conclusions. This result seems to be major problem. The situation is made worse by the fact the assessment with regard to "replacement" rate is rather arbitrary. This is, in contrast to the use of S-R derived benchmarks which are standardized which, of course, is a key objective of WSP assessments.

- Although uncertainty in the data and assessment should *always* be considered in the development of the management regime, the use of "uncertainty" in either the data or benchmarks to downgrade status needs to be discussed. Again, I'm not sure if this is using redundant information or process. For example, the Ricker S_R function was chosen by the authors in the first place to approximate benchmarks because it is more likely to under-estimate productivity and will therefore produce more conservative benchmarks.

- Some of the information in Appendix 5 (i.e. results of workshop group assessments of status) may be more accessible if it was tabulated across the individual groups. This raises the issue of whether or not achieving repeatability and improving objectivity of the process requires more development of the "scoring template" which the groups use to evaluate the CU information – i.e. posing directed questions within the general headings and specific scoring or ranking instructions. Again, this may be an area of further research or guidance to be developed under WSP implementation.

Discussion

Overall, I thought the most useful part of the discussion were the components where the uncertainties associated with the data and analysis were discussed, **especially with regard to statistics inferred from the stock-recruit analysis and how they inform our understanding of current stock productivity**. However, I found the extensive comments with regard to exploitation rate regime somewhat confusing and perhaps inaccurate and these should be reviewed. Most importantly, I'm not sure how they follow from the data and results presented in this paper.

Some specific comments:

- The discussion provides a useful review of the uncertainties associated with the data treatment and analysis. However, in some cases more information could be presented to "frame" the issue. For example: while it is true that current marine exploitation rate estimates are much more *imprecise* than earlier periods it is not uncertain that the exploitation rate has declined significantly since the pre-1998 period.

- The discussion does not provide an analysis of the uncertainties associated with the implementation of the consensuses-based integrated assessment approach. I think this is important, especially given the results of that process.

- I'm not sure I agree with paragraph on page 25 that asserts there is a general opinion that IFR coho have returned to a higher productivity regime. The basis for this assertion appears to be an unfortunate Fishery Notice (Appendix 7) where the author perhaps confuses "productivity" with "production". I think the interaction with fisheries and biological status assessments for IFR coho is a lot more complicated. As noted in the Introduction of the paper, the decline in IFR coho resulted in major fishery reductions in 1998 and continues to create significant hardship through lost opportunity today. In some fisheries, *minor* increases in allowable harvest impacts on IFR coho would result in significant opportunities that do not currently exist.

- In any case, the task here is not to balance the risk associated with harvest and achieving biological objectives (that is the objective of a management plan), but to provide information that supports that **broader discussion** – i.e. specifically to determine current status. The analysis of how various exploitation rates would affect achieving stock objectives for IFR coho was presented and accepted previously through CSAP (i.e. Decker et al. 2014). In the discussion, it would be more useful to review if the data treatments and updated stock-

recruit analysis completed for this paper negate or change the advice resulting from that previous exercise. (I don't believe they do.)

- I absolutely do not understand the point of this statement on page 26: "it must also be inferred that the status designation depends on the on the current fishery management (i.e. ER) conditions, as the spawning escapement on which WSP status is based is directly influenced by the exploitation regime. The sentence is a tautology.

Date: Friday, October 31, 2014

Reviewer: Mike Hawkshaw, UBC

CSAS Working Paper: 2014/15 SAL12

Working Paper Title: Assessment of Interior Fraser Coho Conservation Units' Benchmarks and Status

First, Nicely presented analysis. I have some comments and questions, but thought the whole piece was well written and some quality analysis was performed. My comments and questions fall into three areas: sensitivity of the model to assumptions, appropriateness of the model, and utility of the benchmarks.

1. Did you test the sensitivity of your results to your assumptions? You address these sources of uncertainty, but I have not seen their effects quantified (I might have missed something though).

   Some simple sensitivity analysis would help to characterize not only the uncertainty around the benchmarks, but highlight areas where investments in monitoring could really improve the assessments of these stocks and the benchmark setting process. I have made a short list of quick sensitivity analyses or other diagnostics that I think could really strengthen the work already done. Fell free to address any or all of these.

- For the assumption of 10% age 4 COHO, is this ratio stable over time and between CUs? If you vary it how does that affect the analysis?
- The spawning cite fidelity and hatchery fish assumptions as well as the assumptions about survival rates and and ER made in the "data cleaning" process could mess up your spawner estimates, how sensitive are your results to variability in spawner counts, and how likely are those spawner counts to be wrong? How badly does the errors-in-variables problem affect your results?

  I think the hierarchical analysis was technically well done; however I have a couple of suggestions that I think would strengthen your presentation.

- What is the effect of the hierarchical analysis in this case?
  - Does it pull up the productivity of the weak stocks?
  - You could contrast your results between the hierarchical and non-hierarchical cases and discuss this – or there might not be enough data to fit to some sub stocks without a hierarchical approach that should be a major point of discussion.
- Use of N~(0,0.01) prior for gamma (marine survival term) and med_a N~(1,0.5) seems odd could you justify them? I would prefer to see weakly informative priors with justification for their use that "non-informative" priors. For example I would expect a weakly informative prior for gamma to be centered on some average of the reported marina survival for the last decade or so, with an SD or variance drawn from these same reported survival rates.
- A plot of Posteriors overlaid on priors is usually provided as a diagnostic.

2. Is the model appropriate? A couple of the things you discuss in the paper make me wonder if the 3 parameter Ricker model is the one you should be using for these stocks. You might not be able to switch models at this stage, but it would be nice to see some discussion of why a life-cycle model was not used.

- For the 3-parameter Ricker model vs the two parameter Ricker model did you use a likelihood ratio or other metric to test which model is "best" for the COHO stocks?
- If you wanted to isolate the freshwater stage instead of using a third parameter why didn't you use a life cycle model.
- SPAWNER-SMOLT stream level relationships appear to be your major concern; including a marine survival covariate seems like a clunky way to get at this. The smolt data could be used exclusive of marine survival to generate spawner benchmarks.

3. Are the benchmarks reported appropriate?

- You are looking at very small population sizes in some cases, should you examine PVA or other approaches to quantify the RED (or lower) benchmarks?
- Is it possible to manage to escapement targets on these stocks? Do these benchmarks address the management options available? Would some ER caps that respond to changes in abundance be a more useful set of benchmarks?
    - For example you could envision a scheme whereby you set 30% harvest as a RED (i.e. no harvest rates above 30%) benchmark, 30-20% harvest as an YELLOW, and <20% as a green benchmark. Then if the stocks show declining trends in escapement with these benchmarks in place then change then to 25, 15, and <15 respectively, if they show increases switch to 35,25,<25?

Date: October 30, 2014

Reviewer: Jake Schweigert, DFO, retired

CSAS Working Paper: 2014/15 SAL12

Working Paper Title: Wild Salmon Policy Biological Status Assessment for Conservation Units of Interior Fraser River Coho Salmon (*Oncorhynchus kisutch*)

The report provides a summary of the analyses of stock recruitment data for the five CUs of Interior Fraser Coho Salmon and uses the results to generate benchmarks for evaluating the current status of the populations against the recovery criteria as required by the Wild Salmon Policy. The evaluation was conducted in a workshop setting and results of the deliberations are presented in the report. The report is well written and easily followed and the authors are commended for summarizing a huge amount of information in a succinct presentation and making a fairly cogent story out of some variable and messy data. The dashboard approach to standardizing the biological information available for each stock in the context of the biological benchmarks is enviable and should be supported for other stocks and species attempting to evaluate conservation status. However, it was a challenge to understand and interpret the materials presented in the dashboard given the available time and information. The explanation of the various figures and metrics within the dashboard in the appendices was helpful in understanding what is intended but the document text was not always clear on which figure was being used to make particular inferences. A suggestion is to number each of the figures within the dashboard separately (eg. Figure 15a, b, c, d, etc.) and then refer to the relevant one in the text. A number of the figures were difficult to read because they appear to be pasted from another application and the resulting figure and text is fuzzy, perhaps pasting them into powerpoint first and then saving as a pdf would improve legibility. The dashboard on Figure 15

on page 28 is a good example. A suggestion is to reduce the size of the first figure of the abundance trend and increase the size of the other figures slightly. In particular, the figure of distribution was confusing as my interpretation of the number of sites using a certain percentage of the habitat differed from the reporting in the document. Additional labelling on the y axis (20% increments) would be helpful and an unsorted ranking of the sites would be easier to interpret in terms of relative changes over time. The text around abundance vs. WSP BM and Short-term Trends didn't appear to reflect the data in relation to the benchmarks for a couple of the CUs (i.e. the text said there were x number of years above the upper benchmark and it didn't seem to mesh with data in the figure). It isn't clear whether it was my misinterpretation of the dashboard figure or an error in the text. Perhaps additional explanation of the dashboard figures in the appendices is required.

It was difficult to evaluate the applicability of the stock recruitment analysis because:

1. the effect of infilling data or other pre-processing that was conducted had unclear impacts on the outcome that was not easily understood,
2. there was no presentation of statistics to assess whether the fit of the S/R data was good or poor or statistically significant.

The trace plots are not especially informative and it would have been nice to see the assumed priors plotted with the posterior distributions for the parameter estimates. It was also unclear what the impact of the smolt-adult survival covariate had on the benchmarks, and it would have been interesting to see the result without the use of the covariate. In fact, it isn't clear whether the covariate is independent of the S/R data because the survival rate must have been calculated from recruitment and spawner data. Perhaps an environmental covariate that could reflect survival impacts such as ocean surface temperature might be as effective. Although my experience with S/R estimation is limited, it is surprising that in this analysis parameter estimation for the Ricker function was completed using a linearizing transformation rather than directly with a non-linear estimation algorithm. It was disconcerting to see the large overlaps in the confidence regions for the upper and lower benchmarks for a number of CUs which raises concern about the adequacy of the overall S/R analysis since so many of the metrics in the dashboard rely directly on the results of this analysis.

The absence of any inclusion of habitat in the dashboard was surprising given the importance it is given within the Wild Salmon Policy. It seems to be a major gap in the assessment of recovery potential. Bradford and Irvine (2000) demonstrated a strong relationship between impacts on habitat and productivity of these coho populations and one would have expected a metric to reflect the status of spawning habitat for these CUs. It appears that the availability of freshwater at various times of the year is a critical factor in the survival of smolts and success of spawning for some CUs and developing a simple metric based on mean water level or flow rates averaged over available monitoring sites in each CU that would reflect the amount or quality of available spawning/rearing habitat could be useful.

The most troublesome part of the evaluation of the document was the difficulty in determining how the various metrics were evaluated and weighed against one another in deciding on the overall status of the CU. For example, there are several metrics associated with the results of the S/R analysis and yet for a couple of the CUs it is implied that the recruitment function did not fit the data very well. The document does not explain how the individual metrics were weighted and whether they were given equal weight or some more heavily weighted in reaching a decision on status. Some additional text around this decision making process would be helpful.

The consensus view of the group was that three CUs are in the AMBER zone and two are in the AMBER/GREEN zone. However, there is no explanation of what is implied by the latter

designation and how it might impact decisions or advice around harvest management. It appears to reflect the fact that the CU didn't clearly fit in either category but simply giving it an intermediate designation may have unrealized implications. Additional clarification on this question needs to be added in the revision.

According to the Wild Salmon Policy:

> A Conservation Unit in the Red zone is undesirable because of the risk of extirpation, and the loss of ecological benefits and salmon production. The presence of a CU in the Red zone will initiate an immediate consideration of ways to protect the fish, increase their abundance, and reduce the potential risk of loss. Biological considerations will be the primary drivers for the management of CUs with Red status.
>
> Amber status implies caution in the management of the CU. While a CU in the Amber zone should be at a low risk of loss, there will be a degree of lost production. Still, this situation may result when CUs share risk factors with other more productive units. Decisions about the conservation of CUs in the Amber zone will involve broader consideration of biological, social, and economic issues. Assuming a CU is assessed to be safe in the Amber zone (consistent with Principle 1), then the use of this CU involves a comparison of the benefits from restoring production versus the costs arising from limitations imposed on the use of other CUs to achieve that restoration.

Given the concerns about the quality of data available for the S/R analysis, the limited discussion and reliance on the metric for recruits per spawner was surprising since it seems relatively unaffected by data preprocessing. Indications are that for each CU the number of years below replacement is substantial: Middle Fraser CU (5 of 13), Fraser Canyon (5 or 13), Lower Thompson (4 of 13), North Thompson (6 of 13), South Thompson (5 of 13). With the short time series since 1998, whereby almost 50% of the time the populations aren't being replaced the AMBER/GREEN designation seemed too optimistic for the two CUs and it wasn't clear why some would not have been designated as RED or RED/AMBER. Additionally, while the document acknowledges that the IF Coho are in an unproductive regime it would be worth noting that escapement levels remain at less than 25% of those in the 1980s.

The discussion around smolt production estimates, smolt to adult survival rates and the relative importance of freshwater habitat versus marine effects was confusing. Previous publications about the reasons for the poor productivity of Interior Fraser Coho populations all focus on the reduced marine survival since the early to mid-1990s. The data presented here seem to challenge this viewpoint and if this is now the view of the coho research community then this needs to be more clearly presented and supported with additional analysis. It was also unclear whether the estimate of smolt production was completely independent of smolt to adult survival rate estimates since these estimates both rely to some extent on the estimates of escapement.